Solid Rocket Motor Asbestos-Free Insulation

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205–544–7105

Health-hazard concerns and decreasing availability have necessitated the replacement of the present reusable solid rocket motor asbestos/silicon dioxide-filled, acrylonitrile butadiene rubber internal case insulation material with asbestos-free insulators. The primary objective is to develop and qualify an asbestos-free internal case insulation design that will demonstrate equal or better erosion performance at a reasonable cost.

Material selection procedures with subscale testing have produced two candidate materials which will undergo full-scale testing in late 1995. Aramid-filled, ethylene propylene diene monomer is proposed for both materials. A 7-percent Aramid-filled material is recommended for all of the internal case insulation except for the aft dome, where an 11-percent Aramid-filled insulator may be required. Subscale tests have demonstrated greater erosion resistance with the 11-percent Aramid-filled material in the high-impingement aft dome area.

The design recommendations for the first full-scale motor test were derived primarily from a single 48-inch subscale test motor designed to duplicate the full-scale motor aft dome environment. Analysis had to be based on only three data measurements per station location. This limited data base precluded any traditional statistical analysis approach. A subjective decision had to be made based on all appropriate comparative methods. Mean values (with corresponding variances) were evaluated, along with maximum loss values. Comparison techniques were prioritized and assigned either a conservative or nonconservative rating. Controversial data from two critical stations provided additional concern and were evaluated with less emphasis. Based on an estimated probability of failure no greater than 1 per 100 motors, a decision was made to approve the full-scale test insulation design with less-than-desired reliability in the aft dome area.

Data evaluation methodology established for the two proposed insulation materials will greatly enhance analysis of data from the first full-scale test motor. A similar evaluation based on very limited data will determine the internal case insulation design for subsequent static and flight motors. The results of this endeavor will be a more efficient reusable solid rocket motor in terms of cost and reliability. Innovations derived for the statistical analysis of solid rocket motor internal case insulation erosion performance with limited data should benefit the entire solid rocket motor industry.

Sponsor: Space Shuttle Projects Office

Industry Involvement: Thiokol Corporation Space Operations